

Claims

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1. A method of computer operating system data management comprising the steps of:

10 (a) associating data management information with data input to a process; and

 (b) regulating operating system operations involving the data according to the data management information.

15 2. The method of claim 1 wherein supervisor code administers the method by controlling the process at run time.

20 3. The method of claim 1, wherein, the step (a) comprises associating data management information with data as the data is read into a memory space.

25 4. The method of claim 1, wherein the step (a) comprises associating data management information with at least one data sub-unit as data is read into a memory space from a data unit comprising a plurality of data sub-units.

30 5. The method of claim 1, wherein the step (a) comprises associating data management information with each independently addressable data unit that is read into the memory space.

6. The method of claim 2, wherein the data management information is written to a data management memory space under control of the supervisor code.
- 5 7. The method of claim 6 wherein the supervisor code comprises state machine automations arranged to control the writing of data management info to the data management memory space.
- 10 8. The method of claim 1, wherein the step (b) comprises sub-steps (b1) identifying an operation involving the data; (b2) if the operation involves the data and is carried out within the process, maintaining an association between an output of the operation and the data management information; and (b3) if the operation involving the data includes a write operation to a location external to the process, selectively performing the operation dependent on the data management information.
- 15 9. The method of claim 8, wherein the step (b1) comprises: analysing process instructions to identify operations involving the data; and, providing instructions relating to the data management information with the operations involving the data.
- 20 10. The method of claim 9, wherein the process instructions are analysed as blocks, each block defined by operations up to a terminating condition.
- 25 11. The method of claim 1, in which code of an application is analysed statically in order to create a control flow graph.

12. The method of claim 11, in which the code is analysed before load time.
13. The method of claim 11, in which the code is analysed
5 at load time.
14. The method of claim 11, in which code of an application is instrumented to identify an entry point of a conditional structure in the code and an exit point of
10 the conditional structure, and in which the entry points and exit points are identified from the control flow graph.
15. The method of claim 14, in which the conditional structure includes a conditional expression, a process has a tag associated with a program counter stack and when the entry point of a conditional structure is identified at run-time, a current tag is pushed further on the program counter stack, and a new tag associated with the
20 conditional expression is added to the front of the counter stack.
16. The method of claim 15, in which when the exit point of a conditional structure is identified at run time, the tag from the entry point of the conditional structure is returned to the front of the counter stack.
17. The method of claim 14, in which during all operations from an entry of the conditional structure, the tags of
30 the locations in branching expressions are updated according to the tag of the program counter stack.

18. A computing platform for operating system data management, the computing platform comprising a data management unit, the data management unit arranged to associate data management information with data input to a process, and regulate operating system operations involving the data according to the data management information.
19. The computing platform of claim 18, further comprising a memory space, the computing platform arranged to load the process into the memory space and run the process under the control of the data management unit.
20. The computing platform of claim 18, wherein the data management information is associated with at least one data sub-unit as data is input to a process from a data unit comprising a plurality of sub-units.
21. The computing platform of claim 18, wherein the data management information is associated with each independently addressable data unit.
22. The computing platform of claim 18, wherein the data management unit comprises part of an operating system kernel space.
23. The computing platform of claim 22, wherein the operating system kernel space comprises a tagging driver arranged to control loading of a supervisor code into the memory space with the process.

24. The computing platform of claim 23, wherein the supervisor code controls the process at run time to administer the operating system data management unit.
- 5 25. The computing platform of claim 22, wherein the supervisor code is arranged to analyse instructions of the process to identify operations involving the data, and, providing instructions relating to the data management information with the operations involving the data.
- 10 26. The computing platform of claim 23, wherein the memory space further comprises a data management information area under control of the supervisor code arranged to store the data management information.
- 15 27. The computing platform of claim 19, wherein the data management unit comprises a data filter arranged to identify data management information associated with data that is to be read into the memory space.
- 20 28. The computing platform of claim 27, wherein the data filter is arranged to associate data management information with data read into the memory space from predetermined sources, or alternatively is arranged to 25 associate default data management information with data read into the memory space.
- 30 29. The computing platform of claim 18, wherein the data management unit further comprises a tag management module arranged to allow a user to specify data management information to be associated with data.

30. The computing platform of claim 18, wherein the data management unit comprises a tag propagation module arranged to maintain an association with the data that has been read into the process and the data management information associated therewith.
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31. The computing platform of claim 30, wherein the tag propagation module is arranged to maintain an association between an output of operations carried out within the process and the data management information associated with the data involved in the operations.
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32. The computing platform of claim 31, wherein the tag propagation module comprises state machine automata arranged to maintain an association between an output of operations carried out within the process and the data management information associated with the data involved in the operations.
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33. The computing platform of claim 18, in which code of an application is instrumented to identify an entry point of a conditional structure in the code and an exit point of the conditional structure, the computing platform further comprising a static code analyser to identify conditional branch entry and exit points and a conditional tag propagator for run-time propagation of tags associated with data storage locations included in the conditional structure.
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34. An operating system data management method comprising the step of: identifying data having data management information associated therewith when the data is to be read into a memory space.
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35. The method of claim 34, further comprising the step of: associating data management information with the data if the data is identified as having no data management information associated therewith.

36. The method of claim 34, wherein the data management information associated with data is read into the memory space with the data.

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37. The method of claim 34, further comprising the step of: maintaining an association between the data and the data management information when the data is involved in operations within the process, and associating data management information with other data resulting from operations involving the data.

38. The method of claim 37, wherein the step of an association between the data and the data management information when the data is involved in operations within the process, and associating data management information with other data resulting from operations involving the data.

25 39. The method of claim 37, further comprising the step of: examining the data management information when the data is to be involved in an operation external to the process, and allowing the operation if it is compatible with the data management information.

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40. The method of claim 39, wherein the operation is blocked if it is not compatible with the data management information.

41. The method of claim 39, wherein the operation external to the process is compatible with the data management information subject to including the associated data
5 management information with an output of the operation.
42. The method of claim 34, wherein the data management information identifies a set of permitted operations.
- 10 43. An operating system data management apparatus comprising a data filter arranged to identify data having data management information associated therewith when that data is read into a memory space.
- 15 44. The apparatus of claim 43, wherein the data filter comprises part of a data management unit, and is arranged to associate data management information with the data if the data is identified as having no data management information associated therewith.
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45. The apparatus of claim 43, wherein data management unit is arranged to read the data management information associated with the data into the memory space with the data.
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46. The apparatus of claim 43, wherein the data management unit comprises a tag propagation module arranged to maintain an association between the data and the data management information when the data is involved in
30 operations within the process, and to associate data management information with other data resulting from operations involving the data.

47. The apparatus of claim 46 wherein the tag propagation module comprises state machine automata arranged to maintain an association between the data and the data management information when the data is involved in
5 operations within the process, and to associate data management information with other data resulting from operations involving the data.
48. The apparatus of claim 46, wherein the tag propagation
10 module is arranged to examine the data management information when the data is to be involved in an operation external to the process, and cause the operation to be allowed if it is compatible with the data management information.
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49. The apparatus of claim 48, wherein the tag propagation module is arranged to cause the operation to be blocked if the operation is not compatible with the data management information.
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50. The apparatus of claim 48, wherein the tag propagation module is arranged to perform the operation external to the process subject to including the associated data management information with an output of the operation.
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51. The apparatus of claim 43, wherein the data management information identifies a set of permitted operations.
52. A computer program including instructions configured
30 to enable operating system data management in accordance with the method of operating system data management of claim 1.

53. A computer program including instructions configured to enable operating system data management in accordance with or the operating system data management method of claim 31.

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54. A method of modifying computer code of an application, the method comprising the steps of identifying conditional branches in the code and instrumenting the code to provide information regarding the entry and exit points of the
10 conditional structures.

55. The method of claim 54, in which the modification is carried out before load time.

15 56. The method of claim 54, in which the modification is carried out at load time.

20 57. The method of claims 54, further comprising the step of creating a control flow graph representation of the code and analysing the conditional flow graph to identify
conditional branches in the code.

25 58. An operating system comprising an application code modifying unit arranged to perform the method of operating system data management of claim 1.

59. An operating system comprising an application code modifying unit arranged to perform the operating system data management method of claim 34.

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